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(71) Applicant(s)

Hsu Min Chu
No 26 Lane 48, White-Der Street,
Pei-Tou District, Taipei, Taiwan

(72) Inventor(s)

Hsu Min Chu

(74) Agent and/or Address for Service

Ablett & Stebbing
Caparo House, 101-103 Baker Street,
LONDON, W1U 6FQ, United Kingdom

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(56) Documents Cited

GB 1450191 A GB 1400420 A
GB 0757062 A US 3890515 A

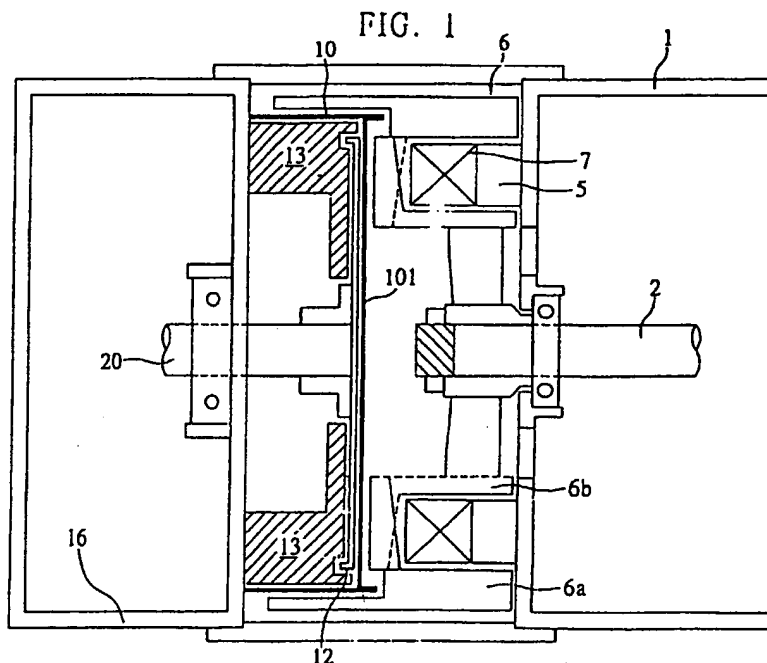
(58) Field of Search

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(54) Abstract Title

Pump driving system using an induction coupling

(57) A motor shaft 2 is coupled to a pump shaft 20 in a non-shaft contacting manner by an induction (eddy current) coupling. Thus, the motor shaft does not penetrate through the housing of the pump and leakage of high pressure fluid or particles from the pump past a bearing seal is avoided. In one embodiment (fig. 1), a coil 7 in a yolk 5 is mounted on a motor housing 1. A first ferromagnetic body 6 is attached to the motor shaft 2, and may be designed as a flywheel for smoothing the driving power of shaft 2. Body 6 has inner and outer rings of teeth 6a, 6b (fig.2) in which north and south poles are induced by coil 7. A non-magnetic, electrically conducting plate 12, which may be made of copper or aluminium, is attached to the pump shaft 20. Magnetic flux from the poles of the first ferromagnetic body 6 passes through plate 12, the magnetic circuit being completed via a second ferromagnetic body 13 behind plate 12 and corresponding to first body 6. The driven plate 12 and the second ferromagnetic body 13 are arranged inside seal cover 10 of pump housing 16. The invention prevents motor failure through ingress of fluid or particles from the pump.



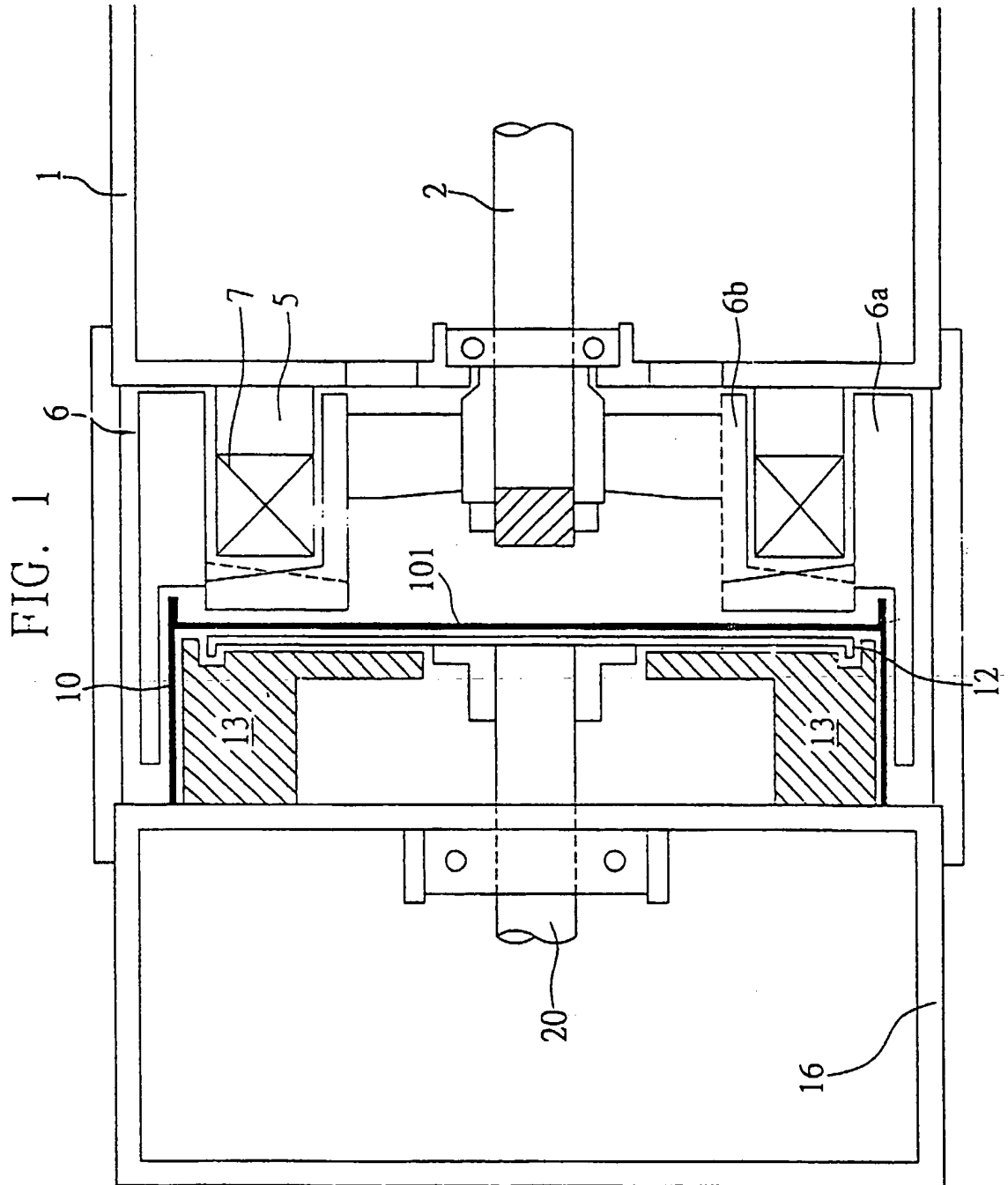


FIG. 2

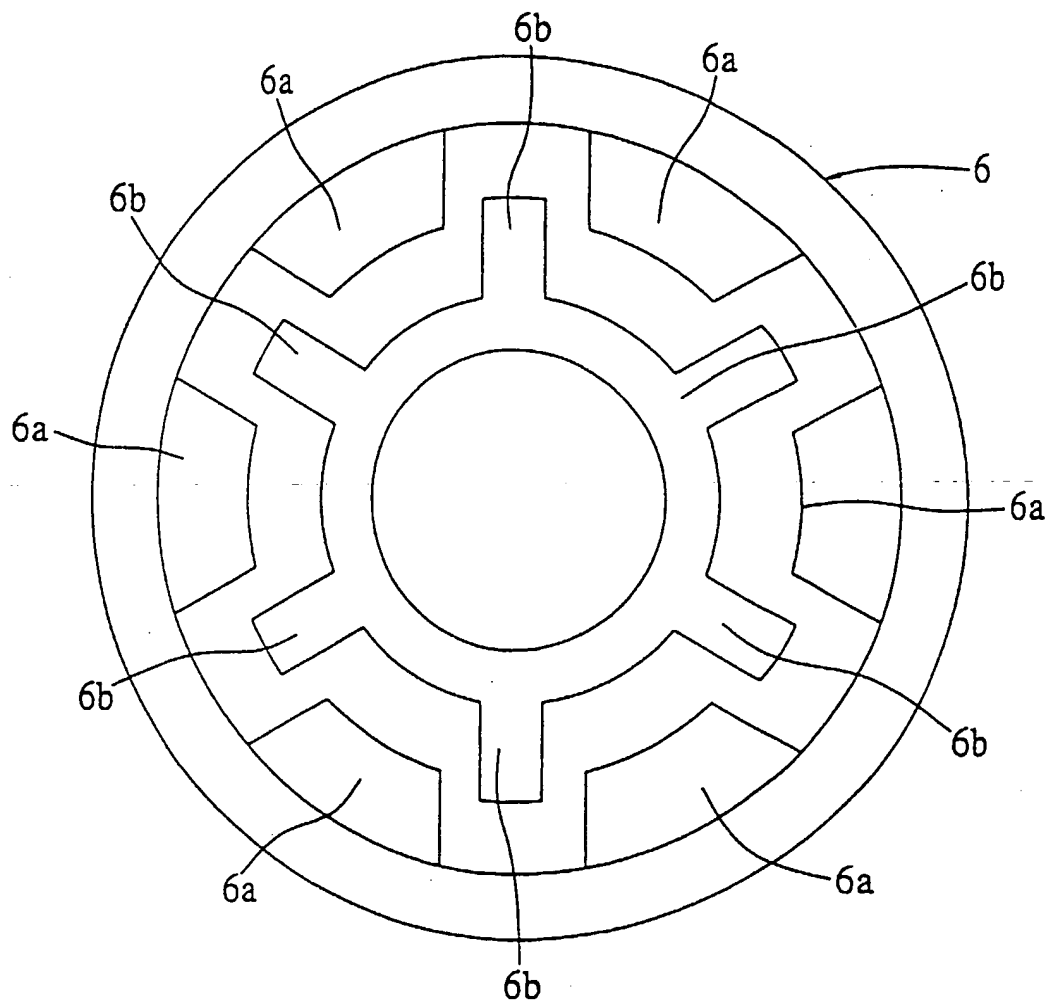


FIG. 3

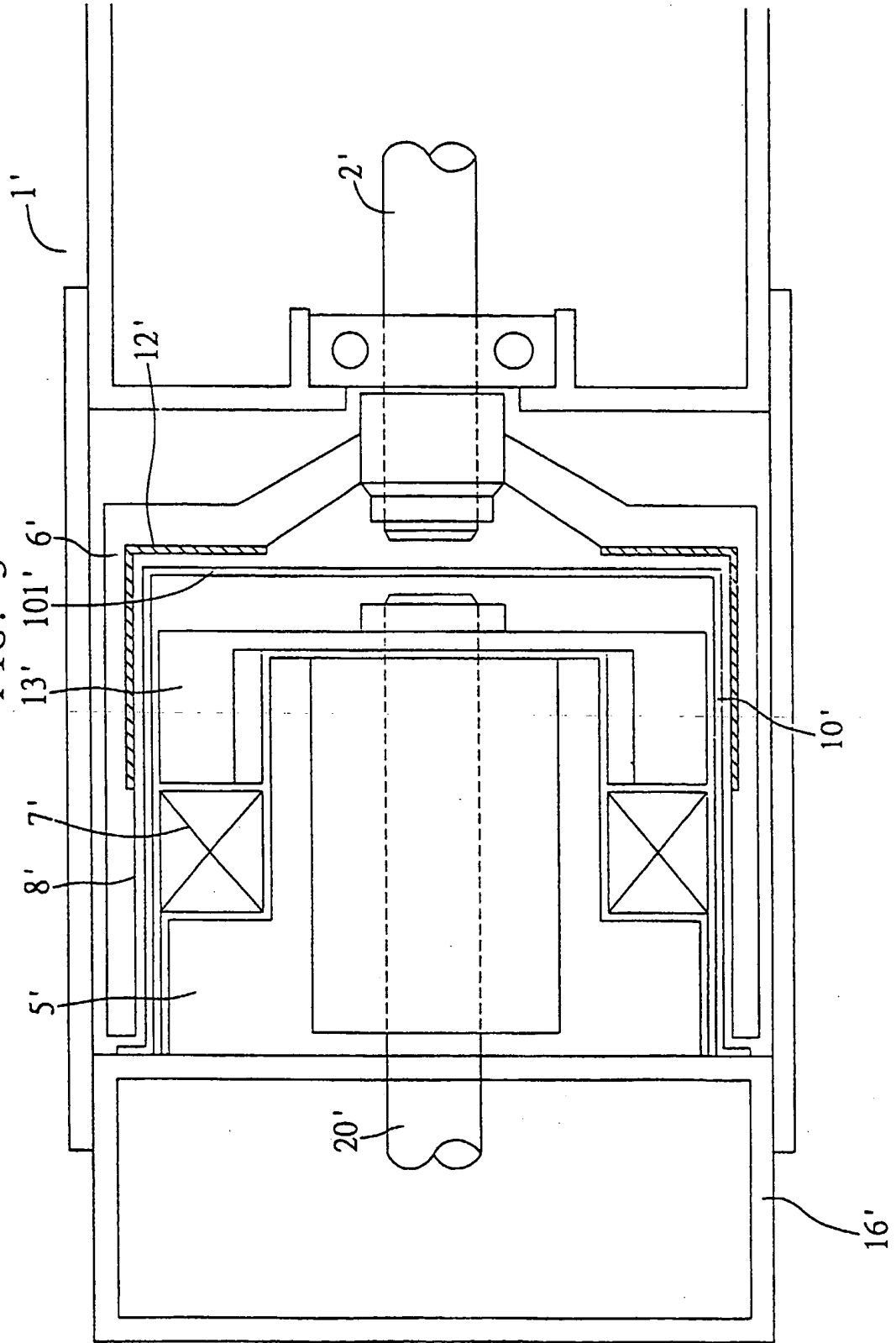
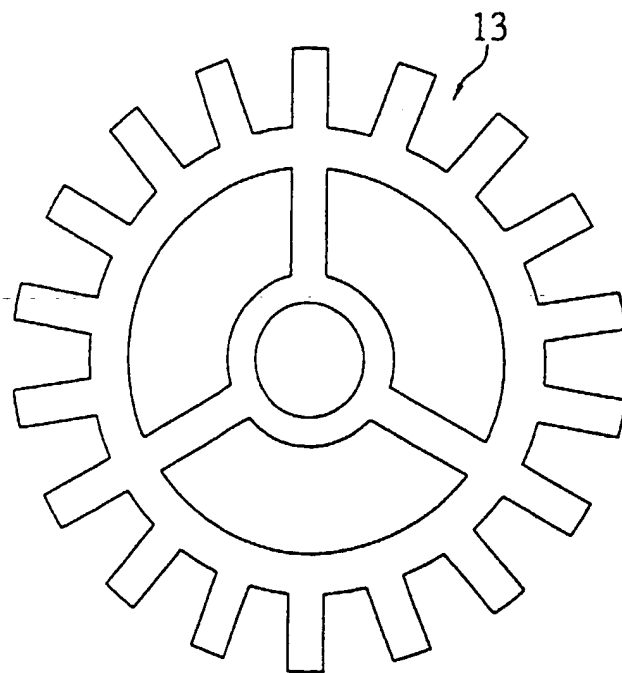


FIG. 4



PUMP DRIVING SYSTEM OF INDUCTION TYPE**FIELD OF THE INVENTION**

The present invention relates to a pump driving system of induction type and, more particularly, to a driving system of induction type for use in a high pressure pump, whereby the pump shaft is rotated in a non-shaft contacting manner so that the pump will be satisfactorily sealed.

BACKGROUND OF THE INVENTION

The existing pump equipments being used in the industrial process are often driven by a motor shaft to maintain a predetermined pressure therein. Such method has to guarantee a gas-tight seal for the motor shaft to prevent the high pressure gas or particles contained therein from leakage of the pump. However, it is quite difficult to have the equipment satisfactorily sealed using such a method. As known, to maintain a normal operation of the motor shaft, it is required to have the pump fitted with a bearing seal to allow the pump shaft to be freely rotated under high speed for maintaining a high pressure gas therein. The motor shaft has to penetrate through the bearing seal or wall so as to drive the pump shaft. It is obviously that the high pressure gas or particles contained therein due to the high pressure thereof is liable to leak through the clearance of the bearing seal, so that it is difficult to maintain a high pressure of the gas and, more worse, the gas or particles contained therein is liable to spread to the interior of the motor, thereby damaging or failing the motor.

In view of the foregoing, the present applicant has contrived a pump driving system of induction type in which the pump shaft is rotated in a non-shaft contacting manner to guarantee a satisfactory seal.

BRIEF SUMMARY OF THE INVENTION

The primary object of the present invention is to provide a pump driving

system of induction type that drives a pump shaft by way of electromagnetic interaction, so that the motor shaft is not required to penetrate through the pump housing so that the pump can be kept in a gas-tight seal to avoid the possible leakage of the high pressure fluid or particles contained therein, so that the fluid pressure of the pump can be satisfactorily maintained and the breakdown of the motor due to the leakage can be prevented.

In accordance with one aspect of the present invention, the pump driving system of induction type comprises:

- a first shaft rotatably mounted on a support housing;

- a second shaft rotatably mounted on a pump housing and having one end at which a seal cover is provided, the seal cover having a circular plate portion being made of electrical-insulated material;

- a first magnetization body mounted on the first shaft and being integrally rotated with the first shaft;

- a yoke mounted on the support housing;

- an electrical coil mounted on the yoke and being positioned adjacent and corresponding to the first magnetization body for generating magnetic flux;

- a second magnetization body being provided inside the seal cover, the second magnetization body being positioned adjacent and corresponding to the first magnetization body, so that the first magnetization body, the second magnetization body, the yoke, and the electrical coil are configured to constitute a closed magnetic path along which the magnetic flux generated from the electrical coil will travel;
- and

- a nonmagnetically electrical-conducting body being provided inside the seal cover and being positioned between the first magnetization body and the second magnetization body, the nonmagnetically electrical-conducting body being mounted

on the second shaft and being integrally rotated with the second shaft; whereby, when the first shaft is rotated, the first magnetization body is allowed to move relative to the yoke and the electrical coil to change the magnetic flux of the closed magnetic path to have the nonmagnetically electrical-conducting body induced eddy current so that the second shaft is capable of being rotated by way of the electromagnetic interaction involved between the eddy current and the magnetic field of the closed magnetic path.

In accordance with another aspect of the present invention, a pump driving system of induction type comprising:

- a first shaft rotatably mounted on a support housing;

- a second shaft rotatably mounted on a pump housing and having one end at which a seal cover is provided, the seal cover having a circular plate portion being made of electrical-insulated material;

- a first magnetization body mounted on the first shaft and being integrally rotated with the first shaft; - - - - -

- a yoke provided inside the seal cover and mounted on the pump housing;

- an electrical coil mounted on the yoke for generating magnetic flux, the yoke and the electrical coil being positioned adjacent and corresponding to the first magnetization body;

- a second magnetization body being provided inside the seal cover and being integrally rotated with the second shaft, so that the first magnetization body, the magnetization body, the yoke, and the electrical coil are configured to constitute a closed magnetic path along which the magnetic flux generated from the electrical will travel; and

- a nonmagnetically electrical-conducting body being positioned between the first magnetization body and the second magnetization body, the nonmagnetically electrical-conducting body being attached to an inner surface of the first

magnetization body and being integrally rotated with the first shaft; whereby, when the first shaft is rotated, the first magnetization body is allowed to move relative to the yoke and electrical coil to change the magnetic flux of the closed magnetic path to have the nonmagnetically electrical-conducting body induced eddy current, so that the second shaft is capable of being rotated by way of the electromagnetic interaction involved between the eddy current and the magnetic field of the closed magnetic path.

Other characteristics and advantages of the present invention will be fully illustrated in the following detailed description with reference to the appended drawings. However, the drawings are illustrative only and do not limit the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematically sectional view of the first embodiment of the present invention.

FIG. 2 is a schematically front view of the first magnetization body of FIG. 1

FIG. 3 is a schematically sectional view of the second embodiment of the present invention.

FIG. 4 is a schematically front view of the second magnetization body of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

According to Lenz's law of the Physics, when a magnetic flux passing through the area enclosed by an electrical circuit is changed, an electromotive force and current will be induced in the circuit. Similarly, when a magnetic flux passing through a nonmagnetic metal block or plate is changed, eddy current will be induced in the block or plate. As a result, the changing magnetic flux passing through the block or plate will interacted with the induced eddy current to thereby exert an electromagnetic force on the block or block so as to oppose the change of the

magnetic flux.

The present invention has applied the principles of the electromagnetic induction to contrive a driving device that employs a nonmagnetic metal block or disk being passed through a changing magnetic flux and being coupled to mechanical means or shaft, so that the electromagnetic force resulting from the interaction of the changing magnetic flux and the eddy current can cause a desired shaft to rotate. The two embodiments of the present invention will be fully illustrated below.

Referring to FIG. 1, the first embodiment of the present invention includes a first shaft 2, a second shaft 20, a first magnetization body 6 being preferably made of ferromagnetic material, a second magnetization body 13 being preferably made of ferromagnetic material, an electrical coil 7, a yoke 5, and a nonmagnetically electrical-conducting body 12. The first shaft 2, being an input shaft driven by a powered equipment (such as a motor) is mounted on a support housing 1 (such as a motor housing). The second shaft 20, being a driving shaft of a high pressure pump for maintaining the pump at a predetermined pressure, is mounted on a pump housing 16. A seal cover 10 having a circular plate portion 101 is provided at one end of the second shaft 20 for preventing the high pressure fluid or particles contained therein from leakage of the pump. Also, the circular plate portion 101 is disposed between the first shaft 2 and the second shaft 20. As shown in FIG. 2, the first magnetization body 6 can be designed as a flywheel structure for smoothing the driving power of the first shaft 2. The flywheel structure is designed to have an outer ring 6a and an inner ring 6b, between which a ring-shaped groove is defined. The outer ring 6a and the inner ring 6b are respectively distributed with opposing magnetic poles (N pole or S pole), being induced from the electrical coil 7 and the yoke 5, along the circumferences thereof. Referring back to FIG. 1, the second magnetization body 13 can be shaped as an annular body that is provided inside the seal cover 10 and is located adjacent and

corresponding to the first magnetization body 6. The yoke 5 is mounted on the supporting housing that supports the first shaft 2. The electrical coil 7 is mounted on the yoke 5 for generating magnetic flux. The yoke 5 and the electrical coil 7 are received in the ring-shaped groove defined by the outer ring 6a and the inner ring 6b. It is to be understood that the circular plate portion 101 of the seal cover 10 is preferably made of an electrical-insulated material to avoid generating unwanted eddy current on the portion, as the eddy current generation of the portion will effect the eddy current induction of the nonmagnetically electrical-conducting body 12 to thereby reduce the driving torque of the second magnetization body 13. According to the arrangement as shown, the first magnetization body 6, the second magnetization body 13, the electrical coil 7, and the yoke 5 are configured to constitute a closed magnetic path along which the magnetic flux generated from the electrical coil will travel. The nonmagnetically electrical-conducting body can be designed as a disk being mounted on the second shaft 20 for being integrally rotated with the second shaft 20. The nonmagnetically electrical-conducting body is provided inside the seal cover 10 and positioned between the first magnetization body 6 and the second magnetization body 13. The nonmagnetically electrical-conducting body can be made of copper or aluminum. According to the arrangement as shown, the nonmagnetically electrical-conducting body 12 is so positioned to allow the magnetic flux generated from the electrical coil 7 to pass through it. Therefore, when the magnetic flux of the closed magnetic path is changed through the rotation of the first magnetization body 6, the nonmagnetically electrical-conducting body 12 will be induced eddy current.

Referring to FIG. 1, when the electrical coil 7 is energized and the first shaft 2 is rotated, the first magnetization body 6 can be rotated to move relative to the electrical coil 7 and the yoke 5 so that the magnitude of the magnetic flux can be changed to have the nonmagnetically electrical-conducting body 12 induced eddy current.

Therefore, an electromagnetic force will effect on the nonmagnetically electrical-conducting body 12 by way of the electromagnetic interaction involved between the magnetic field of the magnetic flux and the eddy current, and this will cause the second shaft 20 to rotate.

Further, in order to adjust the pressure of the high compressed fluid in the pump housing 16, the rotating speed of the shaft 20 shall be controllable. Thus, the present invention is preferably provided with current or voltage means for adjusting the magnetic flux so as to control the shaft speed.

Referring to FIG. 3, the second embodiment of the present invention includes a first shaft 2', a second shaft 20', a first magnetization body 6' being preferably made of ferromagnetic material, a second magnetization body 13' being preferably made of ferromagnetic material, an electrical coil 7', a yoke 5', and a nonmagnetically electrical-conducting body 12'. The first shaft 2', being an input shaft driven by a powered equipment such as a motor, is rotatably mounted on a support housing 1' such as a motor housing. The second shaft 20', being a driving shaft of a high pressure pump, is mounted on a pump housing 16' for maintaining the pump at a predetermined pressure. As shown, a seal cover 10' having a circular plate portion 101' is provided at one end of the second shaft 20' for preventing the high pressure fluids or particles contained therein from leakage of the pump. Also, the circular plate portion 101' is disposed between the first shaft 2' and the second shaft 20'. The first magnetization body 6' is mounted on the first shaft 2' and integrally rotated with the first shaft 2'. As shown, the first magnetization body 6' can be designed as a cylindrical flywheel structure for smoothing the rotation of the first shaft 2'. As shown in FIG. 4, the second magnetization body 13', being formed as a toothed ring, is provided inside the seal cover 10' and is positioned adjacent and corresponding to the first magnetization body 6'. Referring back to FIG. 3, the yoke 5, being formed as

a ring-shaped structure, is provided inside the seal cover 10' and mounted on the pump housing 16'. The electrical coil 7' is mounted on the yoke 5' for generating magnetic flux. The yoke 5' and electrical coil 7' are positioned adjacent and corresponding to the first magnetization body 6'. It is to be understood that the circular plate portion 101 of the seal cover is preferably made of an electrical-insulated material to avoid generating unwanted eddy current on the portion, as the eddy current generation of the portion will effect the induced eddy current of the nonmagnetically electrical-conducting body 12 to thereby reduce the driving torque of the second magnetization body 13'. According to the arrangement as shown, the first magnetization body 6', the second magnetization body 13', the electrical coil 7', and the yoke 5' are configured to constitute a closed magnetic path along which the magnetic flux generated from the electrical coil will travel. The nonmagnetically electrical-conducting body 12', being formed as cylindrical shell, is attached to an inner surface of the cylindrical magnetization body 6' and is capable of being rotated together with the cylindrical magnetization body 6'. As shown, the nonmagnetically electrical-conducting body 12' is positioned between the first magnetization body 6' and the second magnetization body 13'. The nonmagnetically electrical-conducting body 12 can be made of copper or aluminum. According to the arrangement as shown, the closed magnetic path for the magnetic flux generated from the electrical coil is going to pass through the nonmagnetically electrical-conducting body 12' so that, when the magnetic flux of the path is changed through the rotation of the first shaft 2', the nonmagnetically electrical-conducting body 12' can be induced eddy current.

Referring to FIG. 3, when the electrical coil 7' is energized and the first shaft 2' is rotated, the first magnetization body 6' can be rotated to move relative to the electrical coil 7' and the yoke 5' so that the magnitude of the magnetic flux can be changed to have the nonmagnetically electrical-conducting body 12' induced eddy

current. Therefore, an electromagnetic force will effect on the nonmagnetically electrical-conducting body 12' by way of the electromagnetic interaction involved between the magnetic field of the magnetic flux and the eddy current, and this will cause the second shaft 20' to rotate.

Further, in order to adjust the pressure of the high compressed fluid in the pump housing 16', the rotating speed of the shaft 20' shall be controllable. Thus, the present invention is preferably provided with current or voltage adjustment means for adjusting the magnetic flux so as to control the shaft speed.

More further, in order to enhance the magnetization effect of the closed magnetic path, the cylindrical flywheel structure mentioned above can be provided with a ring-shaped iron ring 8' being attached to an inner surface of the flywheel structure corresponding to the electrical coil 7' and the yoke 5'.

As a summary, the present invention has applied the electromagnetic induction principles to contrive a driving device for a high pressure pump in a non-shaft contacting manner so that a motor shaft is not required to penetrate through the pump housing so that the high pressure fluid or particles contained therein can be prevented from leakage of the pump so as to assure the specified life span of the motor.

It will be understood that the embodiment illustrated shows one application of the invention only for the purposes of illustration. In practice the invention may be applied to many different configurations, the detailed embodiments being straightforward for those skilled in the art to implement.

WHAT IS CLAIMED IS :

1. A pump driving system of induction type, comprising:
 - a first shaft rotatably mounted on a support housing;
 - a second shaft rotatably mounted on a pump housing;
 - a first magnetization body mounted on said first shaft and being integrally rotated with said first shaft;
 - a nonmagnetically electrical-conducting body mounted on either said first shaft or said second shaft;
 - a seal cover provided at one end of said second shaft and having a circular plate portion that is made of electrical-insulated material; and
 - means for providing and changing magnetic flux to pass through said first magnetization body, said means being actuated by said first shaft to change the magnetic flux passing through said first magnetization body to have said nonmagnetically electrical-conducting body induced eddy current so as to rotate said second shaft by way of electromagnetic interaction of the eddy current and the magnetic field of the magnetic flux.
2. The pump driving system of induction type as recited in claim 1, wherein said nonmagnetically electrical-conducting body is mounted on said second shaft and integrally rotated with said second shaft, so that the changing magnetic flux is capable of creating an electromagnetic force on said nonmagnetically electrical-conducting body so as to rotate said second shaft.
3. The pump driving system of induction type as recited in claim 2, wherein said means for providing and changing magnetic flux includes an electrical coil and a yoke being mounted on said support housing, wherein said electrical coil is mounted on said yoke for generating the magnetic flux, said electrical coil and said yoke are positioned adjacent and corresponding to said first magnetization body; whereby,

when said first shaft is rotated, said first magnetization body is allowed to move relative to said electrical coil and said yoke so that the magnetic flux provided from said electrical coil and passing through said first magnetization body is going to be changed.

4. The pump driving system of induction type as recited in claim 3, wherein a second magnetization body is provided inside said seal cover and is positioned adjacent and corresponding to said first magnetization body, so that said first magnetization body, said magnetization body, said electrical coil, and yoke are configured to constitute a closed magnetic path along which the magnetic flux will travel, said nonmagnetically electrical-conducting body is positioned between said first magnetization body and second magnetization body, whereby the changing magnetic flux is capable of creating an electromagnetic force on said nonmagnetically electrical-conducting body so as to rotate said second shaft.

5. The pump driving system of induction type as recited in claim 4, wherein said first magnetization body is a flywheel structure.

6. The pump driving system of induction type as recited in claim 1, wherein a second magnetization body is provided inside said seal cover and integrally rotated with said second shaft, said second magnetization body is positioned adjacent and corresponding to said first magnetization body, said nonmagnetically electrical-conducting body is mounted on said first magnetization body and integrally rotated with said first magnetization body, said nonmagnetically electrical-conducting body is positioned between said first magnetization body and second magnetization body, said means for providing and changing magnetic flux including an electrical coil and a yoke is provided inside said seal cover, said electrical coil is mounted on said yoke for generating the magnetic flux, said electrical coil and said yoke are positioned adjacent and corresponding to said first magnetization body, so that said first magnetization

body, said second magnetization body, said electrical coil, and said yoke are configured to constitute a closed magnetic path along which the magnetic flux will travel, whereby the changing magnetic flux is capable of creating an electromagnetic force on said nonmagnetically electrical-conducting body so as to rotate said second shaft.

7. The pump driving system of induction type as recited in claim 6, wherein said first magnetization body is a flywheel structure.

8. A pump driving system of induction type, comprising

a first shaft rotatably mounted on a support housing;

a second shaft rotatably mounted on a pump housing and having one end at which a seal cover is provided, said seal cover having a circular plate portion being made of electrical-insulated material;

a first magnetization body mounted on said first shaft and being integrally rotated with said first shaft;

a yoke mounted on said support housing;

an electrical coil mounted on said yoke for generating magnetic flux, said electrical coil being positioned adjacent and corresponding to said first magnetization body;

a second magnetization body being provided inside said seal cover, said second magnetization body being positioned adjacent and corresponding to said first magnetization body, so that said first magnetization body, said second magnetization body, said yoke, and said electrical coil are configured to constitute a closed magnetic path along which the magnetic flux generated from said electrical coil will travel; and

a nonmagnetically electrical-conducting body being provided inside said seal cover and being positioned between said first magnetization body and said second

magnetization body, said nonmagnetically electrical-conducting body being mounted on said second shaft and being integrally rotated with said second shaft; whereby, when said first shaft is rotated, said first magnetization body is allowed to move relative to said yoke and said electrical coil to change the magnetic flux of said closed magnetic path to have said nonmagnetically electrical-conducting body induced eddy current so that said second shaft is capable of being rotated by way of the electromagnetic interaction involved between said eddy current and the magnetic field of said closed magnetic path.

9. The pump driving system of induction type as recited in claim 8, wherein said first magnetization body is a flywheel structure.

10. The pump driving system of induction type as recited in claim 9, wherein said flywheel structure has an outer ring and an inner ring, between which a ring-shaped groove is defined for receiving said yoke and said electrical coil, and along the circumferences of which opposing magnetic poles are respectively distributed.

11. The pump driving system of induction type as recited in claim 10, further comprising an electrical means for adjusting the current flowing through said electrical coil to adjust the magnetic flux so as to control the rotating speed of said second shaft.

12. The pump driving system of induction type as recited in claim 11, wherein said nonmagnetically electrical-conducting body is shaped as a disk.

13. The pump driving system of induction type as recited in claim 12, wherein said disk is made of copper or aluminum.

14. The pump driving system of induction type as recited in claim 13, wherein said second magnetization body is shaped as an annular body.

15. The pump driving system of induction type, comprising:

a first shaft rotatably mounted on a support housing;

a second shaft rotatably mounted on a pump housing and having one end at which a seal cover is provided, said seal cover having a circular plate portion being made of electrical-insulated material;

a first magnetization body mounted on said first shaft and being integrally rotated with said first shaft;

a yoke provided inside said seal cover and mounted on said pump housing;

an electrical coil mounted on said yoke for generating magnetic flux, said yoke and said electrical coil being positioned adjacent and corresponding to said first magnetization body;

a second magnetization body provided inside said seal cover and being integrally rotated with said second shaft, so that said first magnetization body, said magnetization body, said yoke and said electrical coil are configured to constitute a closed magnetic path along which the magnetic flux generated from said electrical will travel; and

a nonmagnetically electrical-conducting body being positioned between said first magnetization body and said second magnetization body, said nonmagnetically electrical-conducting body being attached to an inner surface of said first magnetization body and being integrally rotated with said first shaft; whereby, when said first shaft is rotated, said first magnetization body is allowed to move relative to said yoke and electrical coil to change the magnetic flux of said closed magnetic path to have said nonmagnetically electrical-conducting body induced eddy current, so that said second shaft is capable of being rotated by way of the electromagnetic interaction involved between said eddy current and the magnetic field of said closed magnetic path.

16. The pump driving system of induction type as recited in claim 15, wherein said first magnetization body is a flywheel structure.

17. The pump driving system of induction type as recited in claim 16, further comprising an electrical means for adjusting the current flowing through said electrical coil to adjust the magnitude of the magnetic flux so as to control the rotating speed of said second shaft.

18. The pump driving system of induction type as recited in claim 17, wherein said nonmagnetically electrical-conducting body is shaped as a cylindrical shell being attached to an inner surface of said flywheel structure.

19. The pump driving system of induction type as recited in claim 18, wherein said nonmagnetically electrical-conducting body is made of copper or aluminum.

20. The pump driving system of induction type as recited in claim 19, wherein said flywheel structure is provided with a ring-shaped iron positioned corresponding to said yoke and said electrical coil for increasing the magnetization effect of said closed magnetic path.

21. The pump driving system of induction type substantially as hereinbefore described with reference to the accompanying drawings.



INVESTOR IN PEOPLE

Application No: GB 0121885.8
Claims searched: 1 - 21

Examiner: Bill Riggs
Date of search: 17 May 2002

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): H2A ARR3

Int Cl (Ed.7): H2A (49/02, 49/04)

Other: Online databases: EPODOC, JAPIO, OPTICS: H2A, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
Y	GB 1450191 A (Pye) see particularly abstract, p.1 ln.65 - p.2.ln.11 and fig.1	1, 8, 15 at least
Y	GB-1400420 A (Davies) see particularly fig.1: cylindrical structure	1, 8, 15 at least
Y	GB 0757062 A (Zozulin) see particularly diaphragm 19	1, 8, 15 at least
Y	US 3890515 A (Sulzer) see particularly pressure tight partition 9	1, 8, 15 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.